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(54) **A roller conveyor**

(57) The invention relates to a roller conveyor comprising one tapered roller 3 or 4, preferably a plurality of tapered rollers, disposed so that an article 7 being conveyed contacts at least two axially separate areas of the roller to impart to that article a rotation about substantially a vertical axis. Preferably such a conveyor will rotate an article through 90°, and is advantageously used in a conveyor having a 90° curve in the region of the roller or rollers. Such a conveyor may be a packaging device.

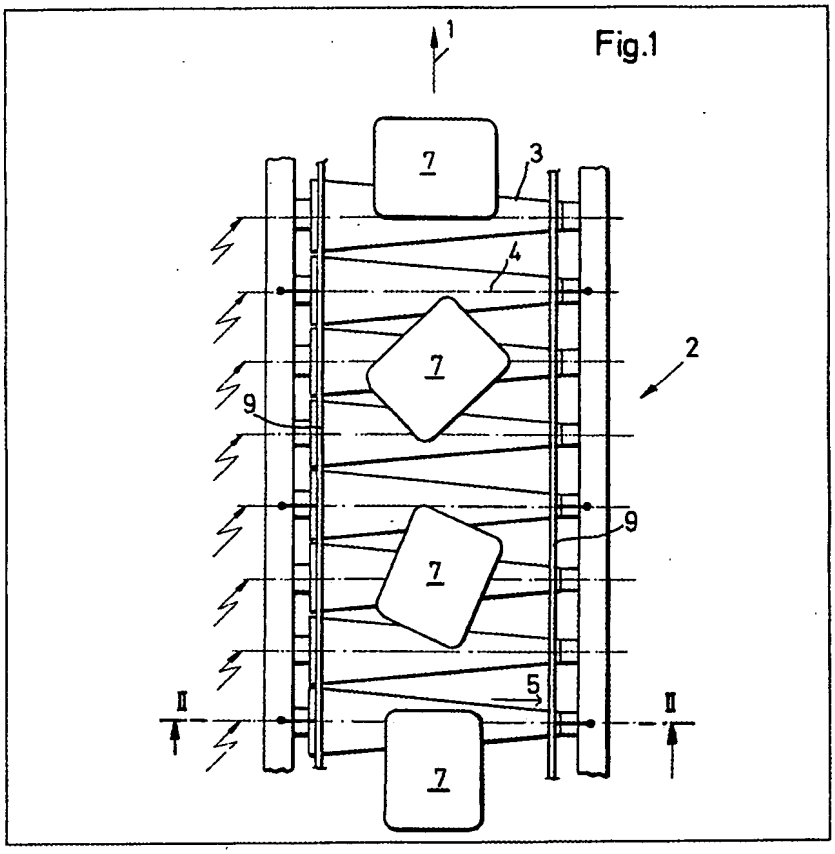

Fig.1

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Fig.1

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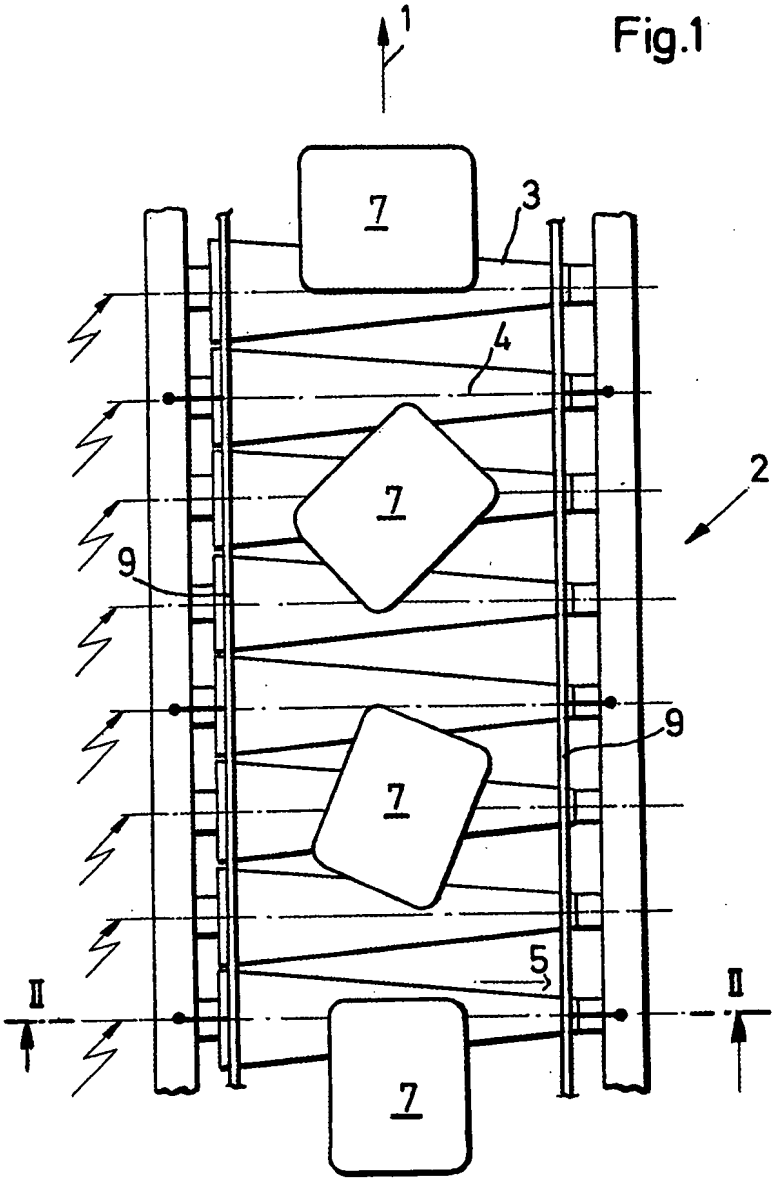


Fig.2

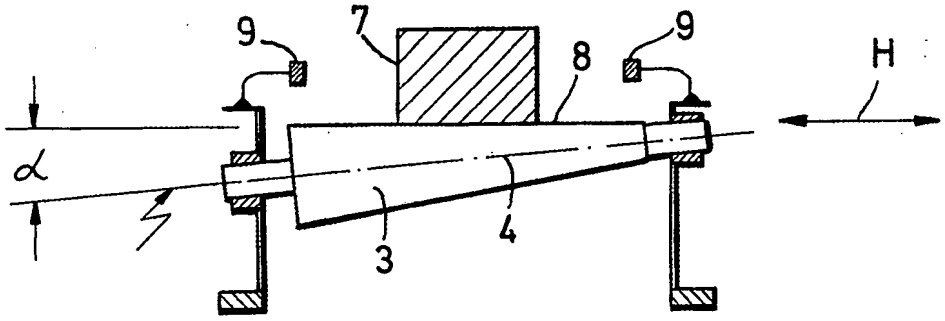


Fig.3a

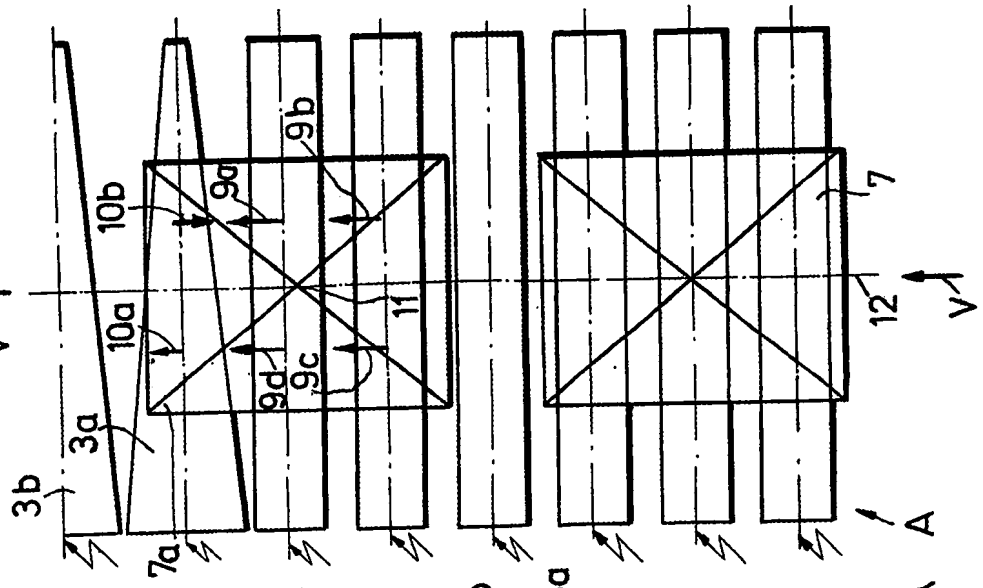


Fig.3b

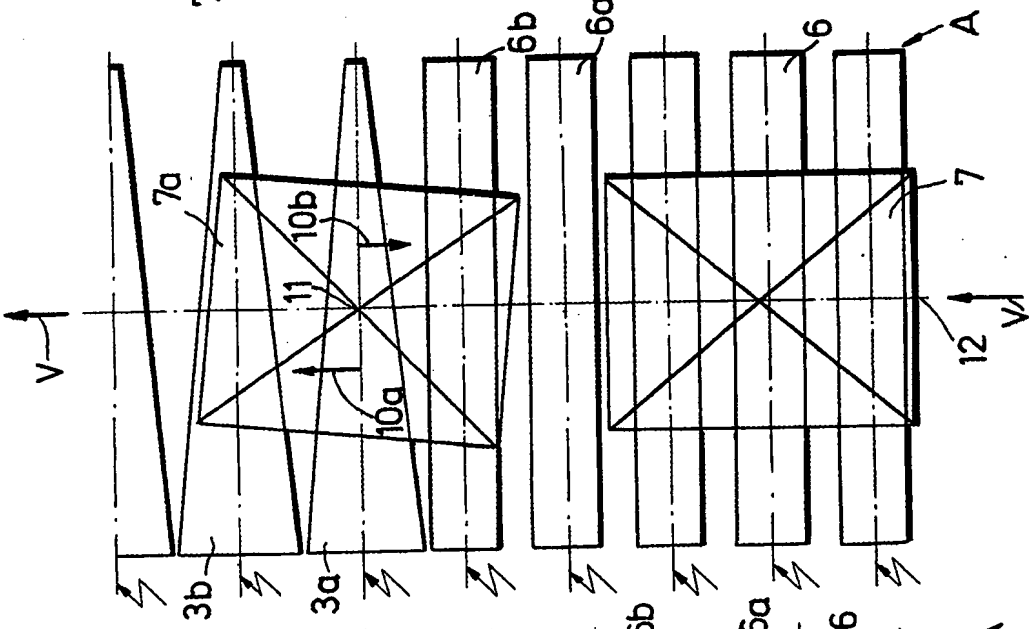
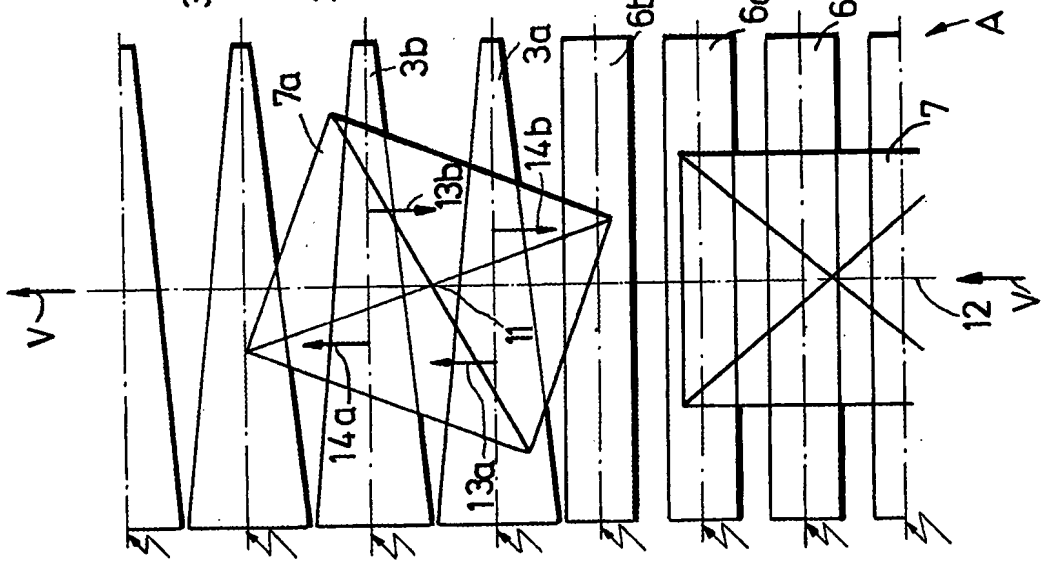


Fig.3c



SPECIFICATION

A roller conveyor

Technical field

The invention relates to roller conveyor for conveying and rotating articles such as rectangular piece goods, for example, boxes or bottle crates, by in each case 90° during the uninterrupted conveying thereof on a conveyor belt such as a roller conveyor. As a result the boxes or bottle crates arriving on a linear conveyor belt, for example, with one narrow side pointing to the front are consequently conveyed from the conveyor with a wide side facing the front after passing the apparatus.

Prior art

Apparatuses of the above type are known for example in German Patent No. 1,283,151. One of the problems set out in that Patent is to bring about the rotation of bottle crates in a very simple manner during continuous conveying without interruption and without a rotating device, which together with a 90° rotating of each create rotates about its and must again be returned into the initial position. The apparatus of German Patent No. 1,283,151 alleviates this problem by replacing the conveyor belt between a feed conveyor and a discharge conveyor aligned with the latter in piecewise manner by a segment of a rotating disc which can be driven in the conveying direction and which extends over the entire width of the conveyor belt and at right angles thereto. Furthermore, in the vicinity of the rotating disc the guard rails of the discharge conveyor are offset in the same direction, the rail extending over the rotating disc having a stepped bend towards the conveyor belt and the opposite outer rail having an outward bulge.

The apparatus of German Patent No. 1,283,151 however has a disadvantage in that the crates are rotated through the braking effect of one corner thereof by it striking against a stop member and then pivoting about the same during further conveying. However, at the corner where pivoting takes place the crate is subjected to an interruption of conveying which extends over the relatively long pivoting time, since when the crate pivots about a perpendicular axis outside the centre of gravity of the crate, which is a relatively large moment of inertia has to be overcome. Thus, the apparatus of German Patent No. 1,283,151 is essentially only suitable for moderate conveying capacities. Furthermore, the apparatus of German Patent 1,283,151 is also largely limited to use in linear conveyor belt systems.

It is an aim of the present invention to provide a rotating apparatus which can be used for high conveying capacities in both linear and curved conveying systems. It is a further aim to provide such an apparatus that is inexpensive, uncomplicated and provides maximum reliability of operation.

Statement of invention and advantages

To this end there is provided according to the invention a roller conveyor comprising one tapered roller disposed so that an article being conveyed contacts at least two axially separated areas of the roller to impart to that article a rotation about substantially a vertical axis.

An apparatus according to the invention makes it possible, e.g. by motor-driven cylindrical rollers with a given speed to convey belt rectangular piece goods, such as boxes or bottle crates fed onto the portion with the motor-driven conical rollers, whilst essentially retaining the charging speed thereof and at the same time to exert a torque brought about by force couples on the piece goods about a perpendicular axis passing through the centre of gravity thereof in such a way that on conveying the article over the portion with the motor-driven conical rollers it simultaneously undergoes a rotation about an axis passing through the centre of gravity of the article and moving with the latter on a path line corresponding to the portion with the motor-driven conical rollers. As over their entire length the motor-driven conical rollers move in the conveying direction on their horizontally arranged apex line all parts of the piece goods are continuously moved in the conveying direction with a high conveying capacity. It is also advantageous that the vertical rotation axis in each case passes through the centre of gravity of the article and as a result the rotation is only opposed by a limited moment of inertia in such a way that rotation takes place rapidly with limited force expenditure, on a continuous basis and without knocking against anything.

Since apart from the proved and tested rollers, which are known to have a long surface life, no other moving parts are required high operational reliability is ensured.

In practice obviously the friction ratios between the motor-driven conical rollers and the individual articles are not precisely the same, so that at the end of the portion with the motor-driven conical rollers said articles can have slightly more or slightly less than the indicated 90° rotation. However, in the known, inexpensive manner this can for example be compensated by a corresponding arrangement of lateral rails. This is particularly recommended when the articles leave the portion with the motor-driven conical rollers in longitudinal manner. However, if they leave this portion in transverse manner it can be advantageous to make the driving speed for the articles in the portion following that with the motor-driven conical rollers such that the rectangular articles engage on one another, so that a reciprocal adjustment is obtained.

An additional advantage of an apparatus according to the invention is that an economic solution for supplying bottle crates in the correct position for the palletizing is provided. Bottle crates having unequal edge lengths can be placed on the pallet in a so-called composite stacking position, this being the position in which the stack is best transported, any other position will cause the crates to drop off the pallet. Up until now it has been necessary to turn the individual bottle crates by means of guide plates or guiding edges projecting into the path of movement of the crates. Quite apart from the resulting damage it is not possible to work with a high supply speed. If

the crates are turned by hand the conveying speed is also considerably reduced to give time for the manual turning operation. Palletizing is made simple if a normal conveyor belt and a conveyor belt of an apparatus according to the invention are connected parallel to the pallet so that unturned and turned crates can be placed simultaneously on the pallet to be loaded.

Further advantages of the apparatus according to the invention are that the rotation of the rectangular articles takes place in a low-impact and low-noise manner, which leads to reduced wear to the articles and to the rotating apparatus, whilst a noise-inhibiting encapsulation which makes operation and servicing more difficult is not necessary.

Figures in the drawings

One embodiment of the invention will now be described, by way of example only, with reference to the accompanying illustrative drawings in which:-

Figure 1 is a plan view of a cutaway portion of a linear conveyor belt with the motor-driven conical rollers of an apparatus according to the invention;

Figure 2 is a section along the line II - II of Figure 1; and

Figures 3a to *3c* are functional sketches showing various stages in a rotation process of the apparatus of Figures 1 and 2.

Detailed description of drawings

With reference to Figures 1 and 2 a portion 2 with motor-driven conical rollers 3 is provided in the linear conveyor belt with an article 7 moving in a direction indicated by arrow 1. The longitudinal axes 4 of conical rollers 3 are at a right angle to the conveyor belt or to the arrow 1 and parallel to each other. Furthermore, the longitudinal axes 4 of conical rollers 3 are inclined by half the cone angle from the horizontal H counter to the tapering direction of conical rollers 3 indicated by arrow 5.

As can be seen from Figures 3*a* to 3*c* in the charging area A for portion 2 of the motor-driven conical rollers 3 of the conveyor belt is formed by motor-driven cylindrical rollers 6.

The rectangular or parallel opidedic article 7 (e.g. bottle crate) undergoes a rotation of essentially 90° during the linear conveying over portion 2 of the motor-driven conical rollers 3. The article 7 is fed to the rotary portion 2 with a forwardly directed narrow side and leaves the rotary portion with a forwardly directed wide side.

As the line of contact 8 between the conical rollers 3 and the bottom of article 7 is horizontal and at a right angle to the conveyor belt the frictional forces driving the motor-driven conical rollers 3 are exerted solely in the direction of arrow 1 on the article 7. Correspondingly article 7 with its centre of gravity 11 moves in the direction of conveyor belt according to arrow 1. At the same time there is a rotation about a vertical axis passing through centre of gravity 11. A guard rail 9 is not operationally necessary and is only installed as a precaution.

The way in which the rotation is brought about is described with reference to Figures 3*a* to 3*c*.

The article 7 is supplied on the motor-driven cylindrical rollers 6 at speed v. According to Figure 3*a* article 7*a* with its front end has already reached the first motor-driven conical roller 3*a* of portion 2 of the motor-driven conical rollers 3, whose circumferential speed in the diameter range indicated by the broken line 12 is substantially the same as that of the motor-driven cylindrical roller 6. Article 7*a*, advanced by cylindrical rollers 6*a* and 6*b* at speed v due to the static frictional forces 9*a* and 9*b*, moves slower with the left half of its front end than with the right half of its front end due to the associated areas of the motor-driven roller 3*a*. This leads to the force couple 10*a* and 10*b* which attempts to rotation of article 7*a* about a vertical axis passing through its centre of gravity 11. However, whilst in the position shown in Figure 3*a* this is opposed by a static frictional resistance on cylindrical roller 6 which cannot yet be overcome.

The resulting static frictional force acting in the centre of gravity 11 of article 7*a* is represented in Figure 3*a* by the four partial forces 9*a* to 9*d* in order to illustrate the countertorque which can be exerted by the latter.

In the meantime article 7*a* is conveyed on at speed v and centre of gravity 11 is still on the conveying line 12 indicated by a broken line. Figure 3*b* shows article 7*a* with its centre of gravity 11 reaching the motor-driven conical roller 3*a*, whereby it is advanced at centre of gravity 11 with speed v. The corresponding driving frictional force is not indicated, but its action line or the perpendicular place containing the same passes in the direction of the conveying line 12 through the centre of gravity 11 of the article. Simultaneously the force couple 10*a* and 10*b* acts on article 7*a* with the tendency to rotate it in a clockwise direction about a perpendicular axis passing through its centre of gravity 11. Whereas in Figure 3*a* article 7*a* is moved on without simultaneous rotation, as a result of the reduction in the torsional loading weight of article 7*a* by static frictional force, the static frictional force on the cylindrical roller 6*b* of Figure 3*b* is reduced and at the same time, due to the increase in the torsional loading weight of the force couple 10*a* and 10*b* or the torque exerted by the latter is increased. After momentary equality the counter-torque of the static frictional force on the cylindrical roller 6*b* is overcome by the torque of force couple 10*a* and 10*b* and, whilst article 7*a* with its centre of gravity 11 continues to advance on conveying line 12, there is simultaneously a clockwise direction about a perpendicular axis passing through the centre of gravity 11. In the position shown in Figure 3*b* article 7*a* has already been rotated clockwise.

As the sliding friction resistance or the sliding frictional force exerted by the motor-driven conical roller 3*a* on the bottom of article 7*a* only occurs in the direction of the movement taking place between article 7*a* and the motor-driven conical roller 3*a*, there is no frictional resistance in the axially parallel transverse direction, i.e. in the direction of longitudinal axis 4 of conical rollers 3 at the start of rotation, because there is still no speed component in this direction. To this extent at the start of rotation the latter is not opposed by a resistance to be overcome.

This is advantageous. However, also during the further rotation of article 7*a* the sliding frictional resistance to be overcome in the direction of longitudinal axis 4 of the motor-driven conical rollers 3 is small. In the case of the sliding movement taking place between article 7 and conical rollers 3 in accordance with the operating direction of the motor-driven conical rollers 3 coinciding with the conveying lines 12 the speed component in the direction of line 12 always predominates as a prerequisite for rotation. The angular speed of rotation essentially occurs in such a way that over the correspondingly component distribution of the relative sliding movement occurring between the article 7 and the motor-driven conical rollers 3 in the operating direction of rollers 3, i.e. in the direction of arrow 1 on the one hand and in the direction of longitudinal axes 4 of rollers 3 on the other the sum of the torques driving article 7 in the rotation direction is at least equal to the sum of the oppositely directed moments of the sliding frictional forces to be overcome directed towards the longitudinal axes 4 of conical rollers 3. If the sliding frictional moments opposing the rotation are too high rotation is slowed down. As a result there is an increase in the relative sliding frictional speed between the article 7 and conical rollers 3 in the same direction on the conveying line (arrow 1) and at the same time there is a reduction in the relative sliding frictional speed between article 7 and conical rollers 3 in the direction of longitudinal axis 4 of rollers 3, so that the driving torque is increased and simultaneously the moment opposing rotation is decreased.

The moment of inertia to be overcome at the start of rotation is also relatively small, because advantageously rotation takes place through a perpendicular axis passing through the centre of gravity 11 of article 7 in such a way that compared with the conventional rotation about a corner of the article 7 temporarily held in the conveying direction the moment of inertia to be overcome by the rotating apparatus according to the invention is smaller by the product of mass times square of the half diagonal length of the base surface of the article i.e. it is considerably smaller.

According to the position shown in Figure 3*c* the article 7*a* with its centre of gravity 11 on conveying line 12 has just reached half the distance between the first conical roller 3*a* and the second conical roller 3*b*. The weight of article 7*a* now rests in approximately equal parts on the two rollers 3*a* and 3*b*. Besides a sliding frictional force (not indicated) exerted in the direction of conveying lines 12 on centre of gravity 11 and which brings about the linear movement of article 7*a* the two force couples 13*a* and 13*b* and 14*a* and 14*b* rotate the article 7*a* in clockwise direction about a perpendicular axis passing through the centre of gravity 11 moved linearly forwards at speed v.

If, for example, due to lack of bottles in the bottle crate the centre of gravity of the article is to assume an eccentric position this is in no way prejudicial. The article is conveyed with its centre of gravity on the conveyor belt, whilst simultaneously there is a rotation about a vertical axis passing through the centre of gravity.

The apparatus of the invention for rotating rectangular articles can be used advantageously in linear conveying, but is in no way limited to this. Due to the basic principle behind said apparatus, it can also be used if rectangular articles have to be conveyed on a curved roller conveyor in a direction which is displaced by 90° relative to the initial direction. In the conventional construction of a curved roller conveyor there is often an undesired 90° pivoting of the article in such a way that it is conveyed in the new direction with the same side and which it was supplied from the old direction.

According to the invention it is possible for example, for the article to enter a curved path with a forwardly directed wide side and to leave it with a forwardly directed narrow side. To this end the motor-driven conical rollers of the apparatus according to the invention are arranged in the curve in such a way that with their tapered end they are directed radially outwards away from the centre point of the curve. Whilst the articles pass through the portion with the motor-driven conical rollers arranged over a curve as a result of the torque exerted due to the direction change of the driving frictional forces occurring from roller to roller is compensated by a corresponding counter-torque due to the special arrangement of the conical rollers according to the invention.

CLAIMS

1. A roller conveyor comprising one tapered roller disposed so that an article being conveyed contacts at least two axially separated areas of the roller to impart to that article a rotation about substantially a vertical axis.

2. A roller conveyor as claimed in Claim 1, comprising a plurality of side by side tapered rollers.

3. A roller conveyor as claimed in Claim 1 or Claim 2, in which the tapered roller or rollers are conically tapered.

4. A roller conveyor as claimed in any one of the preceding claims, in which the longitudinal axis of the roller or each roller is or are disposed substantially at right angles to the direction of conveyance and parallel to each other.

5. A roller conveyor as claimed in any one of the preceding claims, in which the longitudinal axis of the roller or each roller is or are inclined substantially by half the angle of taper to the horizontal plane of contact of the article to be conveyed with the roller.

6. A roller conveyor as claimed in any one of the preceding claims, in which the roller or one or more of the rollers is or are driven rollers.

7. A roller conveyor as claimed in Claim 6, in which the roller or one or more of the rollers is or are driven by means of a motor.

8. A roller conveyor as claimed in any one of the preceding claims, in which the conveyor conveys articles in substantially a straight line.

9. A roller conveyor as claimed in any one of Claims 1 to 7, in which the conveyor has substantially a 90° curve in the region where the roller or rollers are located.

10. A roller conveyor as claimed in Claim 9 when appendant to Claim 2 in which the plurality of rollers have their longitudinal axes directed so that the tapered ends are arranged in a radial manner.

11. A roller conveyor substantially as herein described with reference to the accompanying illustrative drawings.

12. A packaging apparatus including a roller conveyor as claimed in any one of the preceding Claims.

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